

Confidential Information



CD-I Bridge

Specification

Version 1.0

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I. General

I. General

I.1 Introduction

This chapter I.1 is informative.

A CD-I Bridge disc is a CD-ROM XA disc with a CD-I application program, which can be played on a CD-I player. A CD-I Bridge disc can be a Read Only disc or a CD-WO disc. A CD-I Bridge disc can be a Single Session or a Multi Session disc.

The main part of this document specifies the CD-I Bridge disc, whereas the appendices describe the necessary adaptations to CD-I Base Case players and to CD-ROM XA systems in order to support the different functional capabilities of the CD-I Bridge disc.

The CD-I BRIDGE SPECIFICATION VERSION 1.0 replaces the document "AN INTRODUCTION TO CD-I BRIDGE DISC" dated October 1991.

I. General

I.2 Conformance

The CD-I BRIDGE SPECIFICATION conforms to the mandatory requirements specified in this document. All parts in this document are mandatory unless they are specially defined as recommended or optional or informative.

CD-I BRIDGE also conforms to the applicable parts of the system descriptions or international standards that are listed below:

- CD Audio: Compact Disc Digital Audio, specified in the System Description Compact Disc Digital Audio ("Red Book"), N.V. Philips and Sony Corporation.
- CD-ROM: Compact Disc Read Only Memory, specified in the System Description Compact Disc Read Only Memory ("Yellow Book"), N.V. Philips and Sony Corporation.
- CD-I: Compact Disc Interactive, specified in the CD-I Full Functional Specification ("Green Book"), N.V. Philips and Sony Corporation.
- CD-WO: Compact Disc Write Once, specified in the System Description Recordable Compact Disc Systems Part II, Version 2.0 ("Orange Book"), N.V. Philips and Sony Corporation.
- CD-ROM XA: Compact Disc Read Only Memory eXtended Architecture, specified in the System Description CD-ROM XA, N.V. Philips and Sony Corporation.
- Multi Session CD: Multi Session Compact Disc, specified in the Multi Session Compact Disc Specification, Version 0.9, N.V. Philips and Sony Corporation.
- ISO 9660: Information processing - volume and file structure of CD-ROM for information interchange. Ref. No. ISO 9660 : 1988 (E).
- ISO 11172: Information technology - Coding of moving pictures and associated audio for digital storage media up to about 1.5 Mbit/s ("MPEG standard"). Ref. No. ISO 11172 : 1993 (E).

I. General

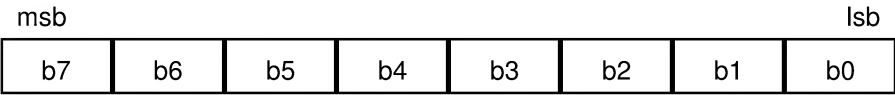
I.3 Conventions

Unless otherwise indicated, in this document the conventions used are as follows:

Bit ordering

The graphical representation of all multiple-bit quantities is such that the most significant bit (msb) is on the left and the least significant bit is on the right.

Figure I.1 Example of bit ordering for one 8 bits byte



The most significant bit is the bit with the highest bit position number.

Bit designation

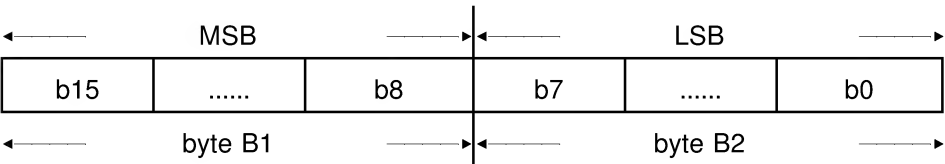
Bit#i denotes the bit with bit position i, according to Figure I.1.

Byte ordering

Quantities which require more than 8 bits for their representation are held in more than one byte on the disc. For all such quantities, the ordering of bytes on the disc is such that the Most Significant Byte (MSB) is first and the Least Significant Byte (LSB) is last.

Multiple-byte quantities are represented graphically such that the left-hand-most or upper-most byte is most significant and the right-hand-most or lower-most byte is least significant.

Figure I.2 Example of byte ordering for 2 bytes



The most significant byte is the byte with the lowest byte position number.

Byte designation

Byte#i denotes the byte with byte position i, according to Figure I.2.

Strings

Strings are always given between double quotation marks, p.e. "_____".

I. General

Hex

All Hexadecimal values are preceded by a \$. The most significant nibble is on the left, the least significant nibble is on the right.

Binary

All Binary values are preceded by a %. The most significant bit is on the left, the least significant bit is on the right. A Binary value is represented by a 0, 1 or x where x is a 0 or a 1.

Decimal

All Decimal values are preceded by a blank space or the range indicator (..) when included in a range. The most significant digit is on the left, the least significant digit is on the right.

Units of measure

1K denotes 1024 units. 1k denotes 1000 units.

Range

Constant_1..Constant_2 or (Constant_1..Constant_2) denotes the range from and including Constant_1 up to and including Constant_2, in increments of 1.

Ordering within tables

The items within a table are contiguous, starting with the top line from the left to the right item, then the next line from the left to the right item, and so on, down to and including the bottom line from the left to the right item.

Multiplication

Multiplication of two values is denoted by a *.

Sector

Wherever the word "Sector" is used in this document it has the identical meaning as the word "Block" in the CD-ROM system description.

Sector, Subcode address

All Sector addresses and Subcode time codes are represented in the form mm:ss:ff. The Minutes field is represented by "mm", the Seconds field is represented by "ss", the Blocks (Sector) or Frames (Subcode) field is represented by "ff".

I. General

I.4 Definitions

Session	An area on a disc consisting of a Lead-In Area followed by a Program Area and a Lead-Out Area is called a Session.
Single Session disc	If a disc contains only one Session, this disc is called a Single Session disc.
Multi Session disc	If a disc contains more then one Session, this disc is called a Multi Session disc.
Track	A Track is a contiguous area on the disc with one and the same Track Number.
Data Track	A Data Track is a Track that contains Sectorized data according to the Yellow Book.
CD-ROM XA Track	A CD-ROM XA Track is a Data Track that contains Sectors in the Mode 2 Form 1/2 format according to the CD-ROM XA specification.
Audio Track	An Audio Track is a Track that contains CD-Audio information according to the Red Book.
Data Session	A Data Session is a Session of which the first Track in the Program Area is a Data Track.
CD-ROM XA Session	A CD-ROM XA Session is a Session of which the first Track in the Program Area is a CD-ROM XA Track.

I. General

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II. Disc Format

II. Disc Format

A CD-I Bridge disc can be a Read Only disc or a CD-WO disc. A CD-I Bridge disc can be a Single Session disc or a Multi Session disc.

In case of a Multi Session disc, there can be more Program Areas on the disc. Each Program Area can contain one or more Tracks. Read Only Multi Session discs are according to the Multi Session CD specification, CD-WO Multi Session discs are according to the CD-WO specification.

The Lead-In and Lead-Out areas of all Sessions on a CD-I Bridge disc conform to the CD-ROM XA specification; note that the Session Type (TOC: PSEC at POINT=\$A0) of all Sessions must have the value \$20.

The CD-I Bridge disc must always be finalized, so it ends with a Lead-out area. Incremental writing, Skip Track and Skip Interval Pointer functions of CD-WO are not allowed. Write disc-at-once and write track-at-once are however allowed.

All Sessions on a CD-I Bridge disc must be CD-ROM XA Sessions. Within one Session, Data Tracks can be followed by other Data or Audio Tracks, but no Data Track can follow an Audio Track. The first Track of every Session starts with a Pre-Gap with a length of 150 sectors. On a CD-WO disc, each Data Track starts with a Pre-Gap conform to the Orange Book. Pre-Gaps must be coded as Empty Sectors of Form 1.

The first Track on a CD-I Bridge disc must have Track Number = 1.

The coding of Audio Tracks is according the Red Book.

II. Disc Format

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III. Data Retrieval Structure

III. Data Retrieval Structure

The data retrieval structure of a CD-I Bridge disc is according to CD-ROM XA Specification chapter III with additions given in this chapter.

III.1 Disc Label or Primary Volume Descriptor (ISO 9660)

The System Identifier (BP 9 to 40) must contain "CD-RTOS CD-BRIDGE" and must be padded with space characters.

The Application Identifier (BP 575 to 702) must contain the Path Name of the CD-I Application Program.

III.2 File Name

Requirements for the File Name in directory records:

- The File Name has a maximum length of 8 d-characters.
- The File Name Extension has a maximum length of 3 d-characters.
- The File Version Number is equal to 1.

III.3 Reserved Sub-directory names

There is a sub-directory to the "ROOT" directory called "CDI" that contains all CD-I specific files. Application Specific standards may use their own reserved sub-directory names.

III.4 CD-I Application Program

The CD-I Application Program is stored in the "CDI" directory. The CD-I Application Program is the program to be executed when the disc is first mounted on a CD-I player. The Path Name of the CD-I Application Program is given by the Application Identifier field of the Primary Volume Descriptor. The Path Name of the CD-I Application Program has the following form: "CDI/CDI_X.APP;1", in which "CDI_X.APP;1" is an example of the file name of the CD-I Application Program.

III. Data Retrieval Structure

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IV. Audio Data Representation

IV. Audio Data Representation

The CD-I Bridge disc audio data format for ADPCM is according to the CD-ROM XA specification chapter IV.

In addition to the audio data formats specified in the CD-ROM XA specification, the following audio data formats can be used on a CD-I Bridge disc:

- **ADPCM Level A**
The data format of ADPCM Level A on a CD-I Bridge disc is specified in the Green Book chapter IV.
- **MPEG Audio**
The data format of MPEG Audio on a CD-I Bridge disc is specified in the Green Book chapter IX.

CD Audio coded audio (16-bit PCM) on a CD-I Bridge disc, must be recorded in Audio Tracks according to the Red Book.

In a Session, the last Data Track preceding an Audio Track ends with a Post-Gap of 150 Empty Sectors in Form 1. The first Audio Track in a Session starts with a pause conform the Yellow Book.

IV. Audio Data Representation

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V. Video Data Representation

V. Video Data Representation

On a CD-I Bridge disc, the following video data formats can be used:

- **CD-I Video**
The data format of the CD-I Video formats is defined in the Green Book chapter V.
- **MPEG Video**
The data format of MPEG Video on a CD-I Bridge disc is specified in the Green Book chapter IX.
- **CD-ROM XA CLUT coding**
The data format of CD-ROM XA CLUT coded video is specified in the CD-ROM XA specification chapter V.

On a CD-I Bridge disc, additional video data formats can be used in the following ways:

- With the Coding Information byte set to \$80, application specific video data formats can be coded.
- Additional video data formats can be specified in a document that specifies a particular application.

V. Video Data Representation

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VI. Multi Session Disc Structure

VI. Multi Session Disc Structure

This chapter gives definitions and requirements for Multi Session CD-I Bridge discs.

The file structure of the CD-I Bridge disc is the same for the entire disc, even if it has multiple Sessions. The disc has one Volume, but the Volume Space spans all Sessions on a CD-I Bridge disc. All Sessions on a CD-I Bridge disc must be CD-ROM XA Sessions. The last Session on a disc contains all information needed to access the entire disc, e.g. the System Area and the Volume Descriptors.

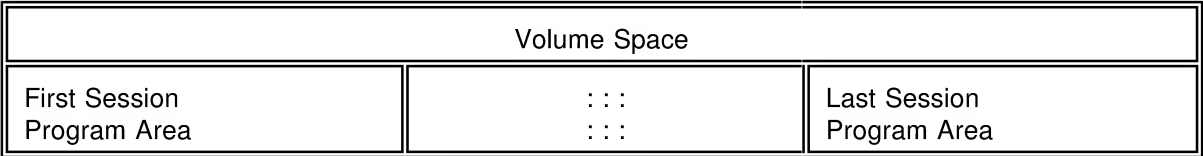
VI.1 Addressing

The Logical sector addressing is the same as used in ISO 9660, and is valid for the entire disc. The Logical Sector Number (LSN) = (((Min*60)+Sec)*75+Frame)-150, where Min:Sec:Frame = Header address or the ATIME in the Subcode Q-channel in case of an Audio Track. A File Extent (see ISO 9660, chapter 6.4.1) may not cross Track boundaries or contain a Link Gap.

VI.2 Volume

The Volume starts directly after the Pre-Gap of the first Track with LSN=0 at Header Address=00:02:00 and ends at the last Sector of the last Track in the Program Area of the last Session on the disc. The Pre-Gap contains Empty Form 1 Sectors (File Number = 0, Submode = 0).

Figure VI.1 Volume Space



LSN = 0

LSN = Vol. Size

VI.3 Gaps

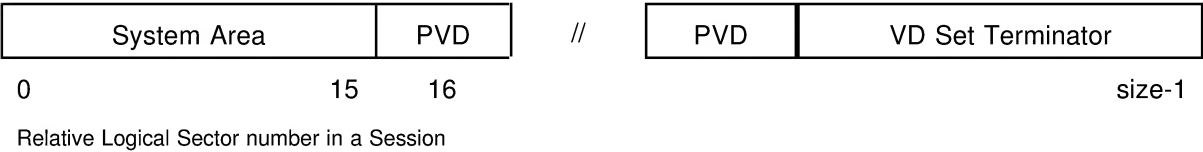
The disc contains areas (Lead-In, Pre-Gap, Link-Gap, Lead-Out) that are not available for recording user data. Note that the Sectors in these areas are normally addressable, (i.e. they have a unique, positive LSN) except the sectors in the Pre-Gap of the first Track and in the Lead-In Area of the first Session.

VI. Multi Session Disc Structure

VI.4 System and Volume Descriptor (SVD) area

The SVD area contains the System Area and all Volume Descriptors of a Session according to ISO 9660.

Figure VI.2 SVD area

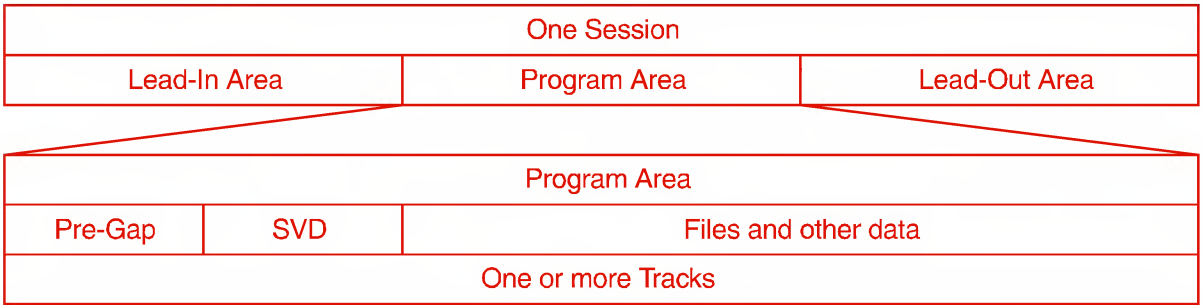


The SVD of the first Session defines the size of all following SVD's on the disc. The SVD in other Sessions must contain the same type of Volume Descriptors as the SVD in the first Session. The SVD area must have the same size (number of Sectors) for all Sessions. Each Session must have an SVD area beginning at an offset of 00:02:00 in the Program Area of that Session. All Sectors that contain the Volume Descriptors of a Session are in Form 1, Non Real Time with File Number = 0, Channel Number = 0, and Coding Information Byte = 0. In the first Session of a CD-I Bridge disc, the SVD starts at LSN = 0.

VI.5 Sessions

The first Track of every Session on a CD-I Bridge disc must be a CD-ROM XA Track, and can optionally be followed by other CD-ROM XA Tracks or Audio Tracks. Each Session contains an SVD area and can contain a Path Table, directory records and application program files.

Figure VI.3 Session



VII. CD-I related data

VII. CD-I related data

In the Green Book, it is specified that a CD-I Base Case player must be able to read data from any CD-ROM disc that has an ISO 9660 file structure. Therefore it is possible to write a CD-I application program that will be able to read data from a CD-I Bridge disc.

The CD-I Bridge disc is useful for data driven applications, in which the same data can be used not only by the CD-I player but also by other (sub-)CD-ROM XA systems. Consequently, the data itself should be recorded in either a CD-I compatible or in a generic format. If the data is in a generic representation format, then the CD-I application program has to convert the data to the proper CD-I presentation format after loading the data from the disc.

The CD-I application executable program files and data files must be produced according to the Green Book.

VII. CD-I related data

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APPENDIX A. System requirements to read CD-I BRIDGE discs

APPENDIX

A. System requirements to read CD-I Bridge discs

A.1 CD Drive requirements

The CD drive must be capable to access the disc for addresses outside the first Lead-Out Area.

The CD drive has to be able to find the offset to the beginning of the last Session. Depending on the choice of implementation one of the following methods can be chosen:

- a) By scanning the disc forward into the blank area to detect the end of the recorded area. Then scan back from there to find the last Lead-Out Area, where an offset pointer to the beginning of the last Program Area is recorded in the Subcode Mode 5 Point=\$B0 (see Orange Book or Multi Session CD).
- b) By scanning the disc Session by Session, and using the Offset pointer to the next Program Area that is recorded in the Lead-In Area of each Session, as Subcode Mode 5 Point=\$B0 (see Orange Book or Multi Session CD), until the last Session is found.

To find out if a Session has been recorded or not can be done by addressing the first Track and see if an EFM signal is present and then quickly return to the recorded area. This is normally done by the servo system. Any attempt to access a blank area will fail and cause an error situation. The time it will take to detect a blank area is drive dependent.

The CD drive should also be able to read the TOC data in the Lead-In Area of all Sessions.

A.2 Device driver requirements

The device driver has to know the SVD area size, which is the same for all Sessions, and is needed for the SVD area re-mapping. The size can be found by counting Sector by Sector, starting from Header Address 00:02:16 until the first Volume Descriptor Set Terminator (BP 1 = 255).

During read, the device driver has to replace all read requests to the first SVD area by read requests to Sectors from the last SVD area. So the Sectors in the SVD area of the last Session replace the Sectors in the first SVD on the disc. I.e. they are physically mapped to the same Sectors in the first Session (= re-mapping) by adding the offset to the last Program Area on the disc to the LSN for these Sectors.

If LSN in $[0..size-1]$
 then $LSN := LSN + Offset_to_last_session$.

A.3 Start-up (or mounting) procedure

At start-up (or mounting) of a disc, a system may want to identify if it is a CD-I Bridge disc. This can be done by checking one or more of the following items:

- 1) That PSEC=\$20 at POINT=\$A0 in the TOC.
- 2) That the System ID in the PVD is "CD-RTOS CD-BRIDGE".

The system has to:

- 2) Determine the SVD area size from the device driver.
- 3) Determine the offset to the last SVD area on the disc from the drive.

A CD-I system must load the executable program code from the file with the path name specified by the Application Identifier field in the PVD.

APPENDIX B. Consequences for the CD-I player shell

B. Consequences for the CD-I player shell

A CD-I Bridge disc contains CD-I application software produced according to the Green Book. However, the execution of the application program from a CD-I Bridge disc is not defined in the Green Book. It is possible that a player shell of the CD-I player has to be adapted to be able to play also CD-I Bridge discs.

Due to the fact that a CD-I Bridge disc can be a Multi Session disc, Multi Session handling must be added to the player shell.

The main identifying points by which the CD-I player can distinguish a CD-I Bridge disc from a CD-I disc is by PSEC=\$20 at POINT=\$A0 in the TOC and that the System ID in the PVD is "CD-RTOS CD-BRIDGE".

APPENDIX C. Differences between CD-WO and replicated discs

C. Differences between CD-WO and Read Only discs

The main difference between a Read Only disc and recordable CD-WO disc is that the Read Only disc is written uninterrupted from the beginning to the end of the disc, and that a CD-WO disc can be written many times. Recordings on a CD-WO disc can not be linked without discontinuities of the EFM clock and the CIRC coding. This means that in the transient (link) area between two recordings a few (Run-Out and Run-In) Sectors will be incorrect and are not usable for User data.

When a CD pick-up passes a link area; first the EFM clock and CIRC decoder will have to resynchronize and then the CD-ROM Sector detector also have to re-synchronize. CD-ROM drives will in some cases need more than the four Run-in Sectors specified by the Orange Book. The first User Data Sectors of a recording are then not readable, though all drives will be able to read data Sectors from 10 Sectors past the link Sector.

In case a Track is recorded at once, then the link area is located in the Pre-Gap before the Track data area. This Pre-Gap is long enough (2 sec) for CD-ROM drives to re-synchronize and in this case there is no problem to read the first User Data sectors in the Track.

APPENDIX D. Writer issues

D. Writer issues

The writer has to support the logical sector addressing as defined in this document.

E. Basic differences between CD-I and CD-I Bridge discs

For a CD-I player to allow playing a CD-I Bridge disc, the player has to accept the following basic differences to a CD-I disc:

- 1) That the PSEC value at POINT=\$A0 in the Subcode TOC is \$20 instead of \$10.
- 2) That the Primary Volume Descriptor is fully ISO 9660:

BP	size	CD-I disc	CD-I Bridge disc
2	5	"CD-I "	"CD001"
9	32	"CD-RTOS"	"CD-RTOS CD-BRIDGE"
81	4	zero	Type L format of BP=85
121	2	zero	Type L format of BP=123
125	2	zero	Type L format of BP=127
129	2	zero	Type L format of BP=131
133	4	zero	Type L format of BP=137
141	4	zero	Type L PathTable location
153	4	zero	Optional type M PathTable
157	34	zero	ROOT directory Record
1025	26	zero	XA Label Record

- 3) That the Volume Descriptor Set Terminator is ISO 9660:

BP	size	CD-I disc	CD-I Bridge disc
2	5	"CD-I "	"CD001"

APPENDIX E. Basic differences between CD-I and CD-I BRIDGE discs

4) That the Directory Record Format is ISO 9660:

BP	size	CD-I disc	CD-I Bridge disc
3	4	zero	Type L format of BP=7
11	4	zero	Type L format of BP=15
25	1	zero	Offset to GMT
26	1	xx	File Flags = 0
27	2	xx	Interleave = 00
29	2	zero	Type L format of BP=31
33	1	n <= 28	n <= 14 ¹
34+n	4	xx	OwnerID = zero
38+n	2	yy	Bits 11-13 XA specific
40+n	2	zero	"XA"
44+n	1 or 5	1 byte zero	5 bytes zero

xx : these bits are application dependent.
yy : for CD-I, bits 11-13 are reserved and set to zero.

5) That the format of the file name is ISO 9660.

¹ File name = Name.Ext;Vers n = File name length (= BP33)

APPENDIX F. Disc design issues

F. Disc design issues

For a successful design of a CD-I Bridge disc, the designer has to consider the following issues:

- User interface specification; the ease of use.
- Disc layout; the order of data and program files on the disc for the best performance.
- Data specific issues; the coding of data on the disc so that the result at presentation on CD-I and other systems is as good as possible. The data must be in such a format that the data can be converted by the application program, or application specific hardware, for each target system, and duplicate data should be avoided.
- Application specific issues; the quality level of audio and video related to the bit-rate and to the total data capacity of the disc. Optional CD-I features may be considered.
- Application program issues; the application program has to include tasks for:
 - User presentation and control.
 - Player and disc control.
 - Data interpreting.
 - Data presentation and control.
- Memory management; CD-I has at least 1 Mb of system memory available, but other systems may have different memory capacity and configurations. So special care has to be taken to avoid memory over and under-flow i.e. that there is room to store data in memory and that data are available in memory when needed by the application.
- Hardware related issues for a specific application player.
- 'Buy and Play' systems; for which the application program other than for CD-I (which is already included) should be on the disc.
- Programming environment; it is recommended to write the application in 'C' programming language or in a higher script language that can be compiled to CD-I executable code and to an other system code if required.

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